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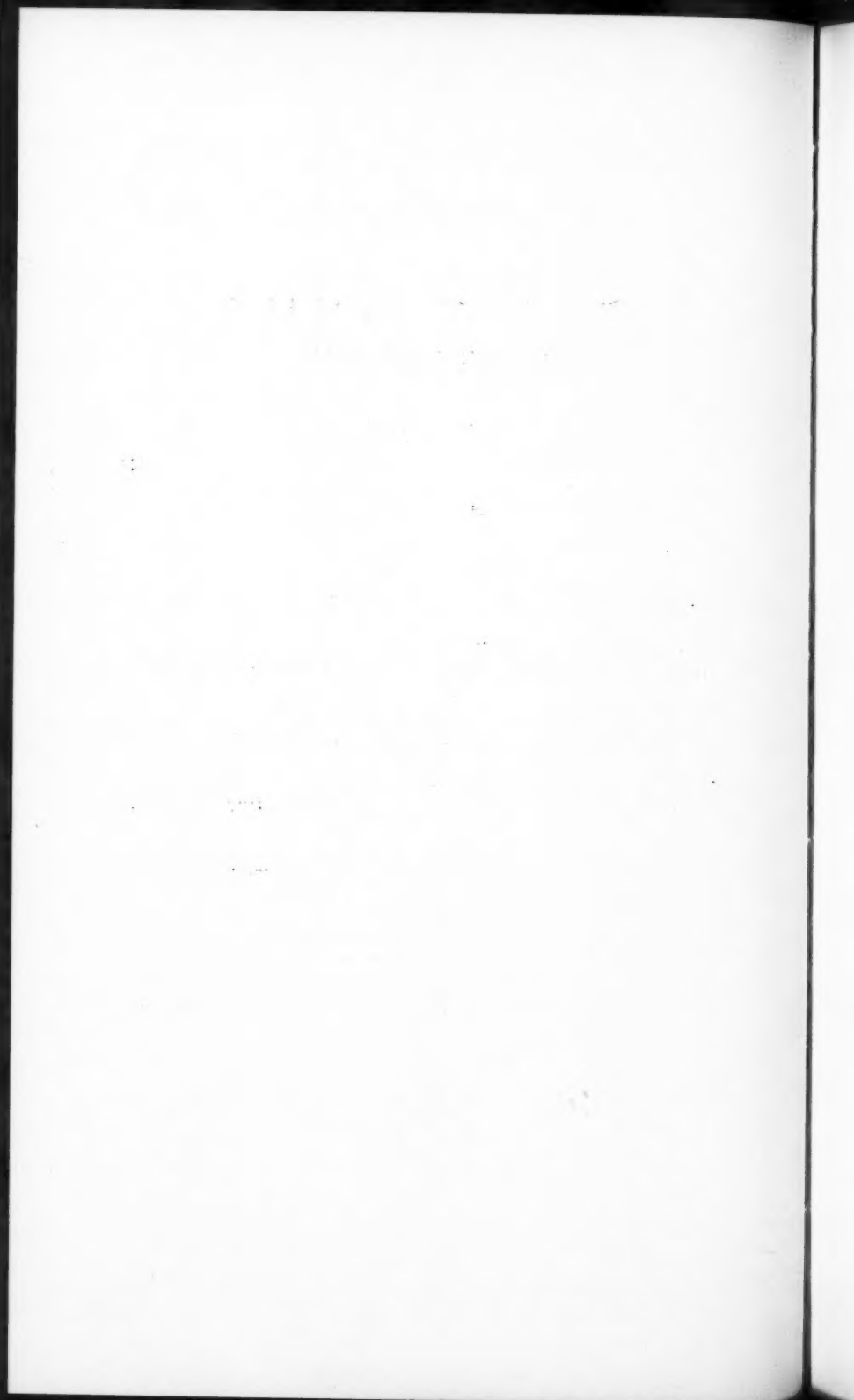
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THE EAST MIDLAND GEOGRAPHER

CONTENTS

	<i>Page</i>
Some Location Factors in the Development of Nottingham <i>K. C. Edwards</i>	. 3
The Keele Surface and the Upper Trent Drainage <i>E. M. Yates</i>	. 10
Some Geographical Aspects of Gas Production in the East Midlands . <i>P. A. Brown</i>	. 22
A Note on the Fletton Brick Company's Works at Bletchley <i>P. S. Richards</i>	. 29
Louth : a North Lincolnshire Market Town <i>H. E. Goulding</i>	. 31
EAST MIDLAND RECORD 37
The New 'Avenue' Coke-Oven Plant at Wingerworth.	
Flax Production in the East Midlands.	
Further Developments in Oil Production in Nottinghamshire.	
Obituary : John Bygott 40



SOME LOCATION FACTORS IN THE DEVELOPMENT OF NOTTINGHAM

K. C. EDWARDS

Nottingham with a population of 311,000 is now the ninth city of the country in size and is the largest centre in the East Midlands, although Leicester its near neighbour (pop. 286,000) approaches it closely in size and importance. Among the location factors which have contributed to the development of the city, at least three are of fundamental importance. The first concerns the nature and properties of the rock formation upon which the early settlement was founded and nurtured, the second concerns the position of the town as a focus of routes, while the third is the presence of coal, the leading factor in its later industrial growth.

THE BUNTER SANDSTONE

Nottingham now spreads over the outcrops of some half-dozen rock formations which converge towards the site of the old town on the north side of the Trent Valley. These include the Middle Coal Measures, the Permian (Magnesian Limestone and Red Marl), the Bunter (Lower Mottled Sandstone and Pebble Beds), the Keuper (Sandstone and Marls) and in addition the gravels and more recent alluvium of the Trent floodplain. With the possible exception of Bristol no city in Britain embraces such geological diversity within its boundaries. The central member of this group of outcrops, i.e. the Bunter Sandstone, provided the site for the early township of Nottingham, the first recorded reference to which relates to an Anglian settlement existing in A.D. 867. This formation, extending southwards through Nottinghamshire, terminates abruptly in a river-cut cliff about two miles long overlooking the Trent floodplain. Apart from very minor occurrences near Rugeley (Staffs.) and Repton (Derbys.) both of which lie on the south bank of the Trent, the appearance of the Bunter Sandstone at Nottingham is without parallel in the long course of the river from the Potteries to the Humber, for with these exceptions the Trent has carved its valley entirely within the Keuper marls and sandstones.

In Nottingham the Bunter formation is chiefly represented by the upper division known as the Pebble Beds. The lower division or Lower Mottled Sandstone appears only as a narrow fringe to the west. Being considerably finer in texture than the Pebble Beds it is worked at Lenton and Bramcote for moulding-sand which is used in the ironworks at Stanton and in the Sheffield area. The Pebble Beds, which attain a thickness of 350 ft. in the city, consist of a coarse buff-coloured sandstone containing bands of rounded pebbles mostly of quartzite. Exposures of these beds are found in many parts of the town—the finest example being the Castle Rock. The characteristic surface features to which this material gives rise may be seen in the Sherwood Forest area north of the city. This is gently rolling country in which slopes are only occasionally steep and in which dry valleys are frequent.⁽¹⁾ The sandstone, being very loose-grained, yields a light and highly porous

(1) H. H. Swinnerton, "The Bunter Sandstone of Nottinghamshire and its influence upon the Geography of the County", *Nottm. Naturalists' Soc.*, 1909-10.

soil with an exceptionally dry surface resulting in a general absence of streams. All these features are evident within the narrow limits of the site of old Nottingham (Fig 1). Thus the two small hills, St. Mary's Hill (150 ft.) and Castle Hill (192 ft.), upon which the original Anglo-Danish and Norman settlements were respectively sited,⁽¹⁾ are typical Bunter eminences, though each appears more prominent on the south side owing to the sheer face of the old river cliff. The broad hollow between them is a typical dry valley grading south and it requires little imagination to see how this depression, by serving as the natural meeting point for the inhabitants of the two communities and by providing easy access to the Trent crossing, later became the market-place of the unified town. As such it has persisted as the city centre.

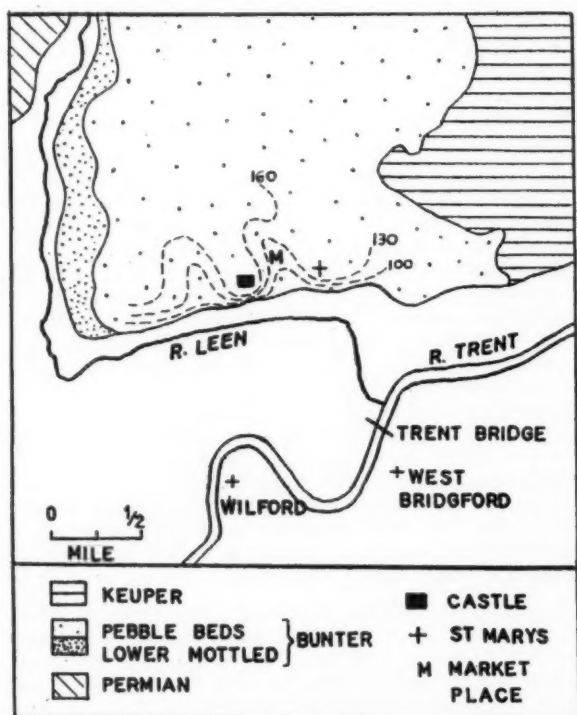


Fig. 1
The site of early Nottingham.

It was not merely the elements of the site however that were provided by the Bunter Pebble Beds. Various characters possessed by this deposit, some of them of major and others of minor consequence, have given individual touches to the urban environment. A few of these may now be mentioned.

(1) Dual settlements resulting from the establishment of Norman garrisons occurred elsewhere e.g. Norwich and Northampton.

Firstly, the coarseness of the sandstone and the general absence of a cementing material cause the rock to be highly porous, quantities of water up to 24% of its volume being readily absorbed. This results in abundant supplies being stored in the lower strata which rest upon the impermeable Permian Marl. Thus while the surface is admirably dry for building purposes, Nottingham has never lacked water. Wells are still common in industrial premises and despite participation in the modern Derwent Water Scheme, about 72% of the municipal supply is still obtained from Bunter wells and pumping stations, one of the oldest being in the city itself at Haydn Road. The water moreover is soft, an advantage in local textile processing, especially bleaching and dyeing.

Another property of the rock is its capacity to remain firm without crumbling after being carved or excavated either by natural forces or by human agency. This is responsible for several distinctive natural features such as the Castle Rock and the large residual stack known as the Hemlock Stone situated a little to the west of the town. In the latter case however preservation has been assisted by a protective capping of harder stone containing a barium sulphate cement. The sandstone being readily excavated, Nottingham has always been a place of caves and cellars. "The rock whereon the town stands," wrote Defoe, "is of a sandy kind, and so soft, that it is hewed into vaults and caverns, and yet so firm as to support the roofs of these cellars, two or three under one another."⁽¹⁾ Though many of these are ancient it is doubtful if any date from prehistoric times. Some occur at the surface as in the Rock Cemetery and in the University grounds or have been hewn from a cliff like the famous inn "Ye Olde Trippe to Jerusalem" at the foot of the Castle Rock and the now forgotten little rock-hewn monastery of St. Mary la Roche⁽²⁾. Most of them are subterranean and are often interconnected by winding passages. Some of the largest, which could easily accommodate over a thousand persons each, were made available to the public as air-raid shelters during the last war. Beneath the Salutation Inn, one of the oldest in the town, a series of caves opened up some years ago appear to have formed an elaborate group of dwellings, possibly of pre-medieval origin. Whether old or new, caves are used extensively for storage since they offer several advantages. They are commodious and cheap, requiring no upkeep; they are dry and preserve a constant temperature of about 51°F. Their use undoubtedly encouraged the survival until recent years of home brewing in the older inns. In 1688 Thomas Smith, a local mercer, developed a subsidiary business by storing valuable articles and eventually sums of money belonging to his clients in the cellars beneath his premises in the market-place and in this manner founded the well-known Smith's Bank, the first of all private banks.

In various other ways the sandstone plays a distinctive part in the environment of Nottingham. A small economy for instance is always effected in building operations, the sand dug in preparing foundations being used for making mortar, while many a garden path in the poorer quarters is cobbled with rounded quartzites collected from the rock.

(1) D. Defoe, *Tour through Great Britain*, 1753, Vol. III, p. 58.

(2) R. M. Butler, "The Common Lands of the Borough of Nottingham", *Trans. Thoroton Soc.*, Vol. LIV, 1950, p. 53.

With the expansion of the town in the late 19th century several roads leading out from the centre were engineered through the steeper slopes by substantial cuttings in the sand rock. Their bare vertical faces, as seen in Wollaton Street, Hucknall Road and elsewhere (including the much older thoroughfares of Hollowstone and Castle Road) provide interesting exposures of the Pebble Beds.

A FOCUS OF ROUTES

Though Nottingham originated at least a mile from the Trent, several axes of movement are seen to intersect in this part of the valley. From the earliest times the river could be forded, except when it rose after prolonged rain, as shown by the place-names Wilford and West Bridgford located on the south bank. Essentially however it was the first bridge, erected in A.D. 920 with a causeway across the floodplain, which fixed the important south-to-north route and gave special significance to Nottingham. This route, coming from the south through Leicester, crossing the Trent at Nottingham and passing thence to Bawtry and Doncaster, still serves as an important alternative to the Great North Road, and as regards the section between Nottingham and Bawtry, is a much superior highway for modern traffic. The concentration of traffic upon the Trent crossing has continued until the present day for as yet there is no other bridge nearer than ten miles upstream and for a similar distance downstream. These are the Sawley (1788) and Gunthorpe (1873) Bridges.⁽¹⁾

Now the bridge-point at Nottingham coincided with the effective limit of navigation, for at Wilford, immediately upstream, gravel shoals have always made the channel difficult and at certain times of the year impassable. During the heyday of inland waterways this drawback was obviated by a lateral canal constructed between Nottingham and Beeston. The contact of road and river routes which in effect dates from Danish times has given opportunity for exchange and transshipment and has enabled Nottingham to exploit its marginal position between the uplands to the north-west and the lowlands to the east and south. The improvement of the river for navigation undertaken by the Nottingham Corporation between 1920 and 1929 and the use of power-driven barges have resulted in a substantial increase in river traffic from the Humber in the past twenty years. Most of the inward cargo is off-loaded to road vehicles at Nottingham for further distribution.

The Trent valley itself, whilst not playing the rôle of a trunk route until the railway age, nevertheless gave direction to two important roads which met at Nottingham. These were the road to Newark (which incidentally carried the first regular mail between London and Nottingham) and that to Sawley Ferry (bridged in 1788) proceeding thence to Tamworth and Birmingham. Both of them kept closely to the edge of the vale, following fragments of river terrace where possible, to avoid floods. Along this natural corridor in 1839 was opened the Midland Counties Railway, the forerunner of the Midland Railway, joining Birmingham, Derby and Nottingham. This was soon afterwards extended to Newark, still keeping to the edge of the vale, and thence to Lincoln. The first direct rail contact with London was made in 1840

(1) Traffic over Nottingham's Trent Bridge has for years been intense, causing serious congestion but a second bridge about a mile upstream is now being built (See *The East Midland Geographer*, No. 3, June 1955, pp. 43-47.)

by the Midland line *via* Trent Junction, the Soar valley and Leicester. By all these routes Nottingham's commercial activity has been continually fostered. Long before the industrial revolution they enabled the town to pass from the stage of a market and garrison centre to that of an important focus of trade. The early importance of commerce is reflected in the reputation of the great Lenton Fair established in 1164 and the famous Goose Fair which certainly existed prior to 1284. Trade is repeatedly emphasised as a primary economic function of Nottingham resulting from its favourable communications in a succession of passages too long to be quoted here by Thoroton, (1677), Deering (1751), Defoe (1753) and Blackner (1815).⁽¹⁾ The later railways and modern roads have manifestly contributed to the extension of this function.

COAL RESOURCES

Nottingham owes much to its position at the southern extremity of the country's largest coalfield. In the absence of authentic records the beginnings of coal production in the district remain obscure, though primitive workings along the Erewash valley, e.g. at Cossall (1348) and Selston (1483) are among the oldest, while at Wollaton, Strelley and Bilborough only a few miles from the town, coal was produced on a considerable scale in the sixteenth century.⁽²⁾ Towards the end of the eighteenth century the introduction of steam power to industry gave Nottingham a long awaited opportunity for economic expansion, for prior to this the absence of suitable streams, a severe handicap as far as textiles were concerned, had prevented the town from sharing in the industrial developments of Derbyshire, Lancashire and the West Riding. The readily worked coal-seams soon became a vital factor in promoting manufacturing, an initial response to which is seen in the erection of the world's first steam-driven cotton mill in 1785 at Papplewick a few miles to the north.

In the Nottingham district as in other parts of the coalfield the Top Hard Seam (the equivalent of the Barnsley Bed in Yorkshire), by reason of its quality, thickness and extent, is of outstanding value. Some collieries work only this seam. In thickness it varies from a little under 3 ft. to more than 6 ft. and contains a layer of high quality coal called Hards which is a first class steam coal; in addition there are bands of good house coal and ordinary manufacturing coal. While it is therefore a composite seam, its importance rests largely upon the Hards. The outcrop of the seam can be traced from the eastern slope of the Erewash valley across to the western environs of the city. It continues eastward but is concealed by an increasing thickness of Permo-Trias rocks. Other workable seams below the Top Hard are the Deep Soft and Deep Hard which yield good steam and domestic coal and the Kilburn which provides excellent house coal.

The inland situation of the mining district and the fact that the coal is primarily suitable for steam raising and household uses cause the surplus output to be directed mainly to the home market, particularly to London and the south. Local consumption for industrial purposes

(1) R. Thoroton, *The Antiquities of Nottinghamshire*, 1677, *passim*.
C. Deering, *Historical Account of Nottingham*, 1751, Section V, pp. 91-101.
D. Defoe, *Tour through Great Britain*, Vol. III, 1753, pp. 60-63.
J. Blackner, *History of Nottingham*, 1815, pp. 201-252.

(2) J.U. Nef, *The Rise of the British Coal Industry*, Vol. I, 1932, p. 59.

is considerable however, while increasing quantities are taken by the large electricity generating stations situated along the Trent. Production from the seven collieries in and immediately around the city (Fig. 2) now amounts to 3½ million tons annually, an output equal to that of the Cumberland, Kent and Bristol fields combined.

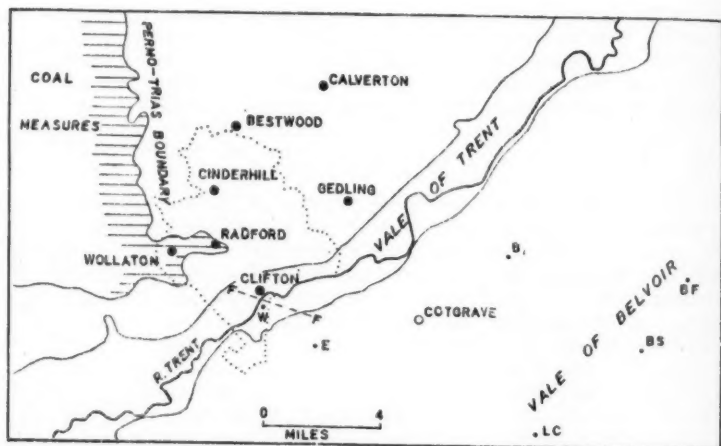


Fig. 2

Nottingham in relation to local collieries.

B—Bingham; BF—Bottesford; BS—Barkestone;
E—Edwalton; LC—Long Clawson; W—Wilford.

The collieries around Nottingham have played a conspicuous part in the development of the coalfield as a whole. Many of the older pits are strung along the Leen Valley, advantageously situated both from the point of view of access to the seams and for the movement of coal by railway. At Bestwood in 1875 the earliest attempt in the district was made to reach the Top Hard through the Trias cover. The shaft, by striking the seam at 1,240 ft. instead of 2,000 ft. as estimated, proved a flattening in the eastward dip of the seam, a matter of great importance to subsequent sinkings, and revealed a thickness of 6 ft. 8 ins. for the seam itself. In turn, progressive exploitation of the Top Hard to the east of Bestwood has necessitated the sinking of a new shaft near Calverton in 1939 and the completion of a large new colliery in 1952. Gedling colliery to the east of the city penetrates 500 ft. of Trias and reaches the Top Hard at 1,377 ft. below the surface and is also known for its High Hazel coal, occurring some 250 ft. above the former and yielding a good ashless house coal.

Of special interest is the Clifton colliery situated on the left bank of the Trent within the city. In earlier years the occurrence of the Top Hard to the south of the river was known for certain only in this colliery. The conditions found here, as revealed in the initial borings, are summarised thus :—

CLIFTON COLLIERY 83 ft. O.D.⁽¹⁾

	Thickness	Depth
Alluvium (including gravel)	25 ft.	0 ft.
Bunter Sandstone	132 ft.	25 ft.
Permian	Absent	
Coal Measures		157 ft.
Top Hard Seam .. 5 ft. 11 ins.		210 ft.
Deep Soft Seam .. 5 ft. 0 ins.		700 ft.
Deep Hard Seam .. 5 ft. 7 ins.		750 ft.

Owing to the absence of the Permian formation which normally provides impermeable strata, the Top Hard at this colliery lies closely beneath the water-laden Bunter and on this account was for long rendered unworkable. Clifton was for years obliged to confine its operations to the Deep Soft and Deep Hard seams. More recently however a method of shaft cementation has enabled the Top Hard to be extracted. These circumstances naturally gave rise to the question of how far to the east and south of Nottingham can coal be exploited. The possibility of working it near Bingham has been contemplated but hitherto economic factors have discouraged the attempt. A boring at Wilford on the south side of the Trent reached a seam, provisionally identified as the Top Hard, but 288 ft. lower than its occurrence at Clifton, the displacement being attributed to the Clifton Fault which runs in an east-south-east direction. To the east of Nottingham more recent borings have shown the presence of Coal Measures, including unidentified seams, at Bottesford, Barkstone and Long Clawson, all in the Vale of Belvoir, while several thick seams have been proved closer to the city at Edwalton, Owthorpe and Cotgrave.⁽²⁾ Moreover the latter evidence indicates reserves at workable depths. In the post-war period the urgent need for increased coal production has led the National Coal Board to begin operations east of Nottingham and a new colliery at Cotgrave, not far from Bingham, is now being sunk. It is expected to raise coal in 1958. Geographically the Cotgrave colliery will be notable in two respects: it will be the first colliery to be located beyond the Trent and it will supersede Clifton as the most southerly in the coalfield.

Summarising, it may be seen that the Bunter Pebble Beds provided for Nottingham an advantageous site and in many respects a distinctive environment for the town. The advantages of Nottingham's position in relation to routes enabled it to exploit its communications for commercial development, while coal, the most important of its natural resources, was the primary means by which it became an industrial city.

(1) Data from the Geological Survey of Great Britain: *The Concealed Coalfield of Yorkshire and Nottinghamshire*, 1951, p. 154.

(2) *North Midland Coalfield: Regional Survey Report*, H.M.S.O., 1945, pp. 10-11.

THE KEELE SURFACE AND THE UPPER TRENT DRAINAGE

A CONTRIBUTION TO THE GEOMORPHOLOGY OF THE COUNTRY ABOUT STOKE-ON-TRENT

E. M. YATES

INTRODUCTION

The presence of a sequence of Tertiary deposits and folding of Mid-Tertiary date has facilitated the task of establishing a denudation chronology for South-East England, and there is a broad measure of agreement as to the age of the major erosion surfaces in that region. In Upland Britain the position is very different. The lack of either Mesozoic or Tertiary deposits has made dating extremely difficult and though a number of different surfaces have been mapped there is no agreement as to their age. They have been variously interpreted as sub-Triassic, sub-Cenomanian and Tertiary. The Midland Province, intervening between the South-East and much of Upland Britain, may well provide an important chronological link. The object of this paper is the description of the drainage and morphology of the North Staffordshire (or Potteries) coalfield, in a regional context and as a possible line of attack upon the problem of the age of the surfaces of Upland Britain.

STRUCTURE

The complex syncline which comprises the major part of the Potteries Coalfield shows a marked asymmetry in its development. Westward it gives place to an intense anticline, along the axis of which, in the north, the Millstone Grit* is brought to the surface (Fig. 1). Dips in the Coal Measures are correspondingly steep and outcrops restricted, save in the south-west where the parallel Apedale and Newcastle faults have preserved wide areas of Upper Coal Measures at the surface. Dips in the east of the syncline are much gentler and the outcrops of the Middle and Lower Coal Measures are correspondingly wide. Beyond them a belt of Millstone Grit country several miles wide intervenes between the coalfield and the nearest eastern outcrops of Carboniferous Limestone. The syncline pitches north so that the eastern Millstone Grit outcrops and those exposed in the Western Anticline coalesce northward in the prominent bastion—the Cloud—which forms the apex to the roughly triangular area of the coalfield.

Southward the whole of these structures is buried beneath Triassic rocks, and the southern boundary of the coalfield is formed by an escarpment of Bunter Pebble Beds. The Trias also rests unconformably against the faulted areas of Upper Coal Measures in the south-west of the coalfield, and the Bunter outcrops make an area of upland which continues the higher ground of the coalfield towards the Shropshire coalfield, forming the natural southern boundary of the Cheshire Plain. In contrast, on the flanks of the Western Anticline the Bunter Pebble

* and the Carboniferous Limestone at Astbury : grid 33/861593.

Beds make a much less impressive feature. Their outcrop has been cut through by the numerous tributaries of the Weaver which rise on the coalfield, and, furthermore, has been overridden by ice. The most prominent feature in the north-west is made by the coalfield itself, an impressive west-facing front of Millstone Grit and Coal Measures (in the Western Anticline) which rises several hundred feet above the drift covered plain.

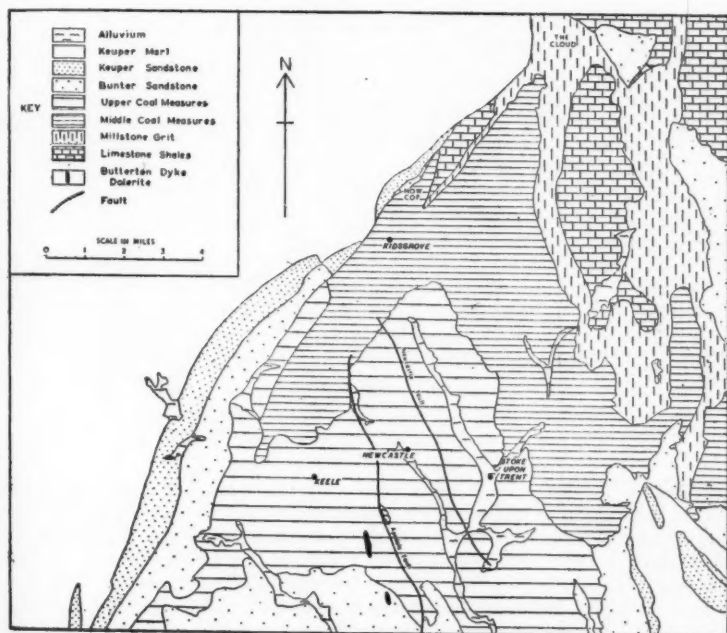


Fig. 1
Geology (simplified). Note that the Limestone Shales are now grouped with the Millstone Grit.

DRAINAGE

The major part of the principal syncline lies within the catchment area of the Trent whilst the northern parts, together with the western parts of the Western Anticline, are drained by streams which make their way to the Weaver. The Trent headstreams, draining an area of gentle dips, have a predominantly north-north-west to south-south-east alignment, occupying the outcrops of the mudstones and shales and leaving the outcrops of the grits and sandstones upstanding as the interfluve ridges (Fig. 2). Only in their upper parts, where they are transverse to the structure, do they show a marked lack of accordance. The Weaver drainage by contrast is mainly transverse to the structures and has been affected by ice damming: even so, longitudinal streams are present in the small down-faulted zone of Upper Coal Measures on the west of the Western Anticline (Fig. 2 west of "Audley Gap").

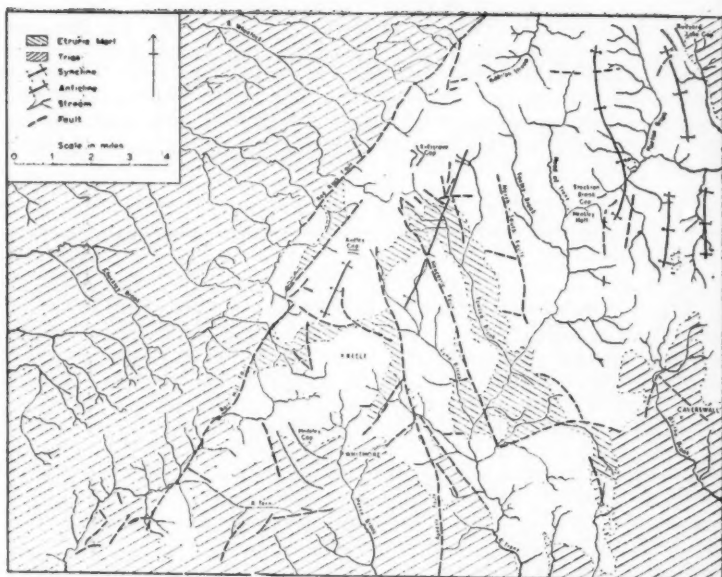


Fig. 2
Structure—showing faults and flexures together with the outcrops of the Etruria Marl and the Trias.

Below Heakley Hall the Trent turns south-south-west and cuts across the flanks of the syncline, receiving its major tributaries on the right bank. This north-north-east to south-south-west alignment, if continued north-north-east, points towards a prominent gap in the Millstone Grit feature which bounds the coalfield on the east. This gap is now occupied by the diminutive Stockton Brook. Beyond the gap drainage is to the Churnet. There has been glacial diversion here.⁽¹⁾ It would appear that the Horton Brook was a more easterly headstream of the Trent. Indeed the upper Churnet possibly had a similar relation. The Horton Brook, the upper Churnet and the intervening Rudyard Lake features repeat the north-north-west to south-south-east alignment of the present Trent headstreams.

This alignment, which is so distinctive a feature in the drainage pattern, is clearly influenced by the general south-south-east grain of the Carboniferous country in the eastern half of the area. It is not entirely explicable in these terms, however, for the following reasons. First, the alignment extends into the Western Anticline and therefore beyond the regions where this grain exists. Indeed, the alignment at one time may have continued further north-north-west since the present Trent Headstreams head back to deep cols (Fig. 2). These cols, though later shaped by ice and melt water, probably originated as the result of successful piracy by the Weaver streams. Secondly, the alignment is

(1) W. Gibson, C.B. Wedd and A. Scott, "Geology of the Country around Stoke-upon-Trent", *Mem. Geol. Surv.*, 3rd Edition, 1925, p. 74.

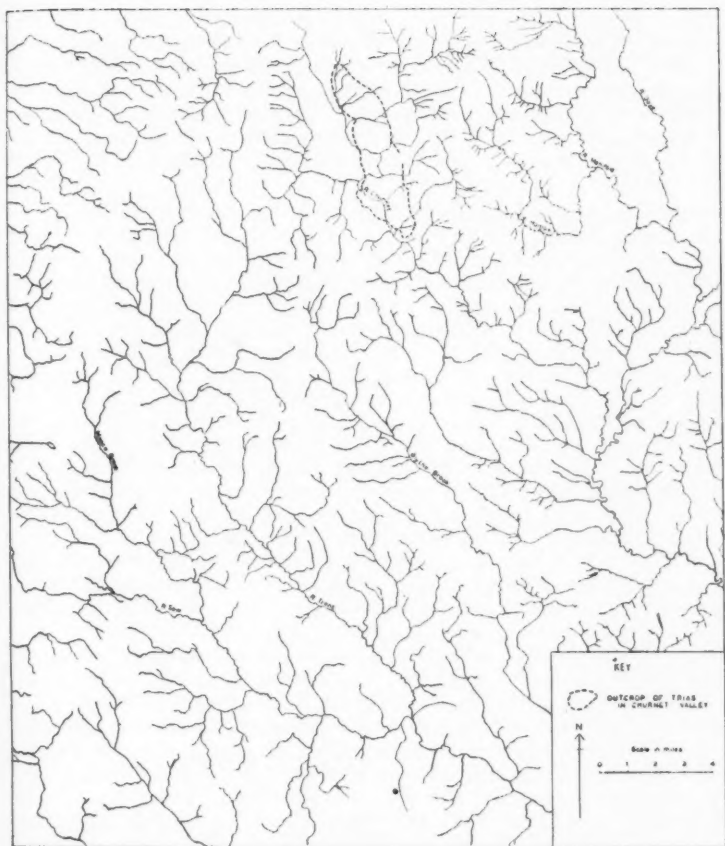


Fig. 3

Drainage with outcrop of the Trias in the Churnet valley indicated.

followed by streams like the Meece Brook and the Blythe Brook (Fig. 3). The courses of these streams are almost entirely on Trias and there is no question of the grain of the Carboniferous rocks. The alignment is probably therefore a legacy from some ancient south-south-east sloping surface in the western Pennines on which the present drainage originated. Removal of the material of which this surface was composed led ultimately to superimposition—but in the main synclinal area the superimposition was largely conformable with the grain. This conformation no doubt has been further emphasised by adjustment. The drainage pattern, with its high degree of integration bears the impress of age. The integration of the drainage effected by the present Trent trunk stream was probably facilitated by the Etruria Marl outcrops (Fig. 2; note area of Trent confluence with the Fowlea Brook and Lyme Brook), and by the fault structures in the Trias, as will be discussed later.

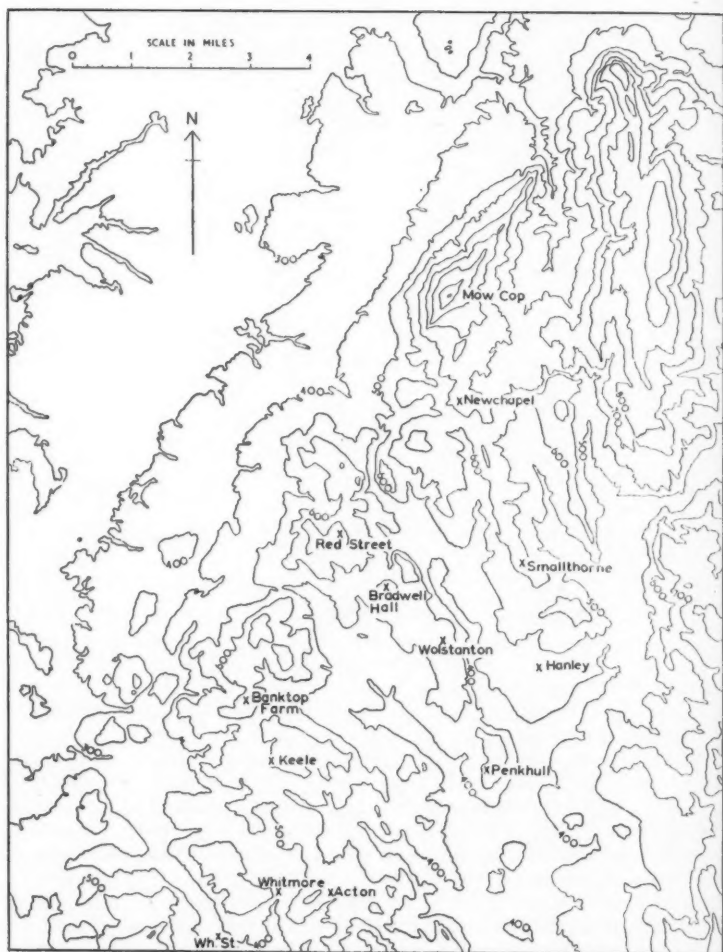


Fig. 4
Relief—vertical interval 100 ft.

MORPHOLOGY

The Millstone Grit edges stand prominent above the coalfield and reach 1,000 ft. in height (Fig. 4). Seen from these eminences the coalfield is even-crested. From any lesser vantage point the skyline is conspicuously level and there is ample evidence of an erosion surface. In the south-west, especially on the Upper Coal Measure outcrops near Keele, this surface, gently undulating, is widespread at a height of 550 ft. with relief of the order of 100 ft. The surface, here termed the Keele surface, is the more notable since it carries the main English drainage divide. Into its western edge the Weaver headstreams are deeply

etched, and from it eastward go Trent headstreams. The upper valleys of the latter are mature but, lower downstream, show a valley-in-valley form. The contrast in the vicinity of Keele is between the Weaver drainage, cut deeply into the surface, and the upper valleys of the Trent tributaries which are part of the surface. The contrast tends to be limited to the Keele vicinity, where the Trent tributaries, because of their situation in relation to the major spillways, escaped deepening by melt water.

The Keele surface rises northward from the Upper Coal Measure outcrops and reaches 700-750 ft. in the Western Anticline, until the Millstone Grit is exposed at Mow Cop. The interfluvies between the Trent headstreams, more restricted remnants of the same surface, show a similar rise northward (Fig. 4). Thus the Lyme Brook-Fowlea Brook interfluvie rises from 500 ft. at Penkull to 550 ft. at Wolstanton, 600 ft. at Bradwell Hall and to 728 ft. at Red Street where it reaches the Western Anticline. The Fowlea Brook-Foxley Brook interfluvie rises from 500 ft. at Hanley to 600 ft. at Smallthorne, to 714 ft. at New Chapel (or Thursfield). The undulating character of the surface around Keele, and its relationship with the unrejuvenated Trent headstreams, suggests a sub-aerial origin. The general rise of the surface northwards, shown both by the larger remnants in the south-west and the interfluvies, further suggests that it was cut by, or developed in relation to the Trent, at some earlier stage. The series of east-west profiles, projected northwards, lends support to this interpretation (Fig. 5). That this surface should now form part of the main English drainage divide is consistent with the view, already discussed, that the Trent drainage formerly extended further west—witness the gaps at the heads of the Fowlea Brook, Lyme Brook and Meece Brook. This is quite consonant with the structure. The three gaps are well to the east of the Red Rock Fault or the Barr Hill Fault which bound the coalfield westward (Fig. 2). These faults bring Trias against the Carboniferous and it is reasonable to suppose that such a juxtaposition would develop into a divide. If an even more ancient Trent ever extended further north-west, the wide expanses of Keuper Marl would have afforded such an advantage to the developing drainage of the Cheshire plain that these extensions would have been quickly lost, and the divide stabilised on the fault line feature. The divide is now further east and a strip of Carboniferous country over a mile wide is drained by the Weaver tributaries, further suggesting a long series of successful piracies by headward erosion of these westward flowing streams.

Projected Profiles of North Staffordshire Coalfield and adjacent areas

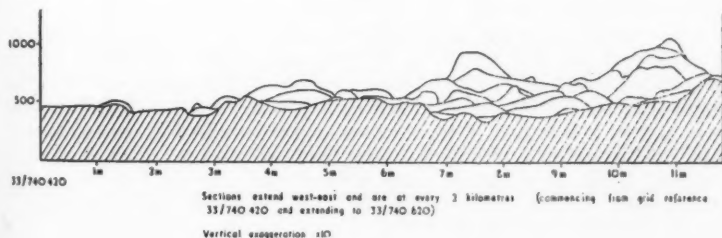


Fig. 5 Projected profiles.

To summarise the inferred sequence of events—the Trent drainage forms part of a family of ancient south-south-east flowing streams. This drainage was superimposed from some higher cover, and the superimposition of the central Trent head-streams upon the Etruria Marl outcrop conferred upon those streams a heritage which confirmed their rôle as trunk streams. The integrated system cut a gently undulating surface falling south-south-east from 750 to about 500 ft. The present interfluvies and the area around Keele in the south-west are remnants of this surface, left by the rejuvenated system cutting down to a lower level. This rejuvenation has been multiple and there are terraces at various levels downstream—for example the 400 ft. terrace in the vicinity of Trentham. The present Trent drainage, however, is only a remnant of a more widespread system, for the catchment area has diminished. In the north-west there has been a long continued reduction due to the recession of the divide; in the north-east there has been the more spectacular loss due to glacial damming. This sequence, as sketched, would appear economical in hypothesis, but is certainly not the only possible interpretation of the North Staffordshire landscape.

THE SUB-TRIASSIC HYPOTHESIS

A very different interpretation is implied in the Geological Survey memoir to the Stoke-on-Trent sheet. Gibson, discussing the Triassic rocks, suggests that the sub-Triassic surface in the area had not been completely peneplaned but possessed considerable relief. The Trias had covered the whole of the coalfield and from some parts had quite recently been removed.

"... in Staffordshire the ancient hollows of denudation remain and the infilling sandstones and gravels of the Trias are only partially or but recently removed as at Endon and in much of the Trent river system, while a completely infilled valley doubtless exists beneath the Trias of the Caversall-Blythe Bridge area."⁽¹⁾

Certain of the Lower Coal Measures are red-stained and this is attributed in part to the Triassic rocks recently removed. Gibson describes the physiography as containing elements of great antiquity. Though he recognises that certain streams show clear evidence of post-Triassic superimposition, he recalls the suggestion of Jukes that the main drainage of the Trent antedates the Trias. It would appear, therefore, that Gibson saw the Keele surface as a sub-Triassic feature, cut by a pre-Triassic ancestor of the Trent, covered, and now exhumed with presumably a little modification. The later drainage would tend to pick up the older lines by adjustment to the Triassic infilling—as the Clwyd in North Wales and the Nith in South Scotland. In time these ancient lineaments would be added to the discordances due to superimposition.

It is to be noted that the concept of peneplanation is not in dispute. It cannot be said that Gibson ignores the denudation of Upper Tertiary time, since that period in his view may have been taken up with the removal of the Triassic and post-Triassic sediments. Both interpretations accept a complete Triassic cover of the coalfield as is consonant with the present outcrops and the outliers, without mention of the red staining. The questions at issue are—simply—the age of the Keele surface and the extent to which the Trent drainage of today reflects the pre-Triassic drainage pattern.

(1) *Ibid.*, p. 61.

It is this question of age which, as indicated, is of more than regional interest. A Triassic origin has been suggested for certain of the surfaces of Upland Britain. Professor W. B. R. King has recently suggested that such surfaces in the South-West Peninsula are probably pediplains formed in Triassic times and now exhumed.⁽¹⁾ He further suggested that the Cheshire plain may have been an old basin of deposition with similar pediments peripheral to it. Similarly the High Plateau of Wales is considered to be a sub-Triassic surface by Professor O. T. Jones.⁽²⁾ These uplands are, however, far from the present Triassic outcrops. The demonstration of a Tertiary origin for the Keele surface, where the peripheral outcrops of Triassic rocks so strongly suggest a Triassic age, is therefore of particular importance. It is a problem analogous to the separation of the Pliocene marine bench and the sub-Eocene surface in the Chilterns and North Downs, save that there is in North Staffordshire one preponderant surface to be dated.⁽³⁾

THE EVIDENCE OF THE DIP

The integration of the Trent head-streams takes place before the river makes its southern exit from the coalfield. The feature due to the Bunter Pebble Beds in the south is, therefore, little broken by water gaps. Though the line of the outcrop is irregular, the feature still is distinct and fairly continuous. It is indeed an escarpment, and, from a viewpoint on the crest (e.g. at Whitmore), it is easy enough to visualise the undulating surface of the Carboniferous rocks extending north as an exhumed surface, revealed as the escarpment retreated. But at Whitmore or Acton the base of the Bunter is at 570 ft. approximately, and the undulating Keele surface extends 3 miles north before the height of 722 ft. is reached at Bank Top Farm on the Western Anticline (Fig. 4). That is to say, the surface has a fall southward of about $\frac{1}{2}^\circ$. Measured from the descent of the base in the Whitmore valley and from the width of outcrop, the southward dip in the Bunter is from 3° to 4° . If, in view of the irregular base of the Bunter, this latter figure is not wholly reliable, it must be noted that dips measured in exposures are commonly higher.

This discrepancy between the slope of the Keele surface and the dip of the Bunter Pebble Beds can be explained in two ways which are consonant with the surface being sub-Triassic. Either the Keele surface formerly rose southwards at a $3\frac{1}{2}^\circ$ angle, and this southern rise has been changed to a northern one of $\frac{1}{2}^\circ$ (giving the Bunter Pebble Beds the necessary southerly dip slope of 4°), or else the Bunter Pebble Beds changed dip along the line of the present outcrop. The first explanation can hardly be entertained without a system of east-west faults in the north of the coalfield. In considering the second explanation, the western outcrops of the Bunter Pebble Beds must be borne in mind. These are faulted against the coalfield along the Red Rock and Barr Hill Faults. Dips are steep; the width of the outcrop suggests a dip of approximately 8° , whilst some measured dips are above 20° . They

(1) W. B. R. King, "Geological History of the English Channel", *Quart. Journ. Geol. Soc.*, No. 437, Vol. CX, Pt. I, 1954, pp. 77-101.

(2) O. T. Jones, "Some Episodes in the Geological History of the Bristol Channel", Presidential Address to Section C, *Report of the British Association for the Advancement of Science* 1930 (1931), p. 80.

(3) S. W. Wooldridge and D. L. Linton, *Structure, Surface and Drainage in South East England*, London, 1955, p. 54, fig. 16.

suggest the possibility that the adjacent areas of the coalfield moved *en bloc*, flexuring as well as faulting the mantle of Trias. If this explanation is to apply in the south (to explain a change in dip), then a similar system of southern east-west faults is required. No such faults have been mapped.

THE EVIDENCE OF THE FAULTS

Of more immediate importance, however, is the undoubted presence in the coalfield of north-north-west to south-south-east faults. There are three major examples—the North and South Fault, the Apedale Fault, and the Newcastle Fault (Fig. 2).

These faults are pre-Triassic in origin, but the Apedale Fault extends well south into the southern Triassic outcrop, so there have been movements along these lines in post-Triassic time. Gibson notes in the memoir that the faults in the Trias appear to follow the fault lines in the Carboniferous rocks. Where the Triassic cover remains it is much faulted, and there is no reason to suppose that such post-Triassic movement was confined to areas in which Triassic remnants demonstrate it. It must presumably also have occurred within the confines of the exposed coalfield. Indeed the small outlier of Bunter Pebble Beds on the Apedale fault is clear witness to this.

This movement would obviously have disrupted the sub-Triassic surface and such a surface, if recently exhumed and but little modified, should show the marks of such disruption. The amount of the disruption, that is the amount of post-Triassic throw, is admittedly less than the pre-Triassic movement. Nevertheless where measurable, as in the south-east, it is of the order of 200 ft. The east-west section lines, crossing at least two of three major north-north-west to south-south-east faults named (and along which post-Triassic movement of this order is surely most probable) show no such disruption. On the contrary there is accordance in crest heights across the faults; in other words the Keele surface (Fig. 5).

ATTRITION OF THE BUNTER ESCARPMENT

Finally, it is to be noted that the Bunter escarpment reaches no great height above the southern level of the Keele surface. The thickness of these Bunter Pebble Beds is variable but at Whitmore Station, where there is included some mottled sandstone, it is 600 ft. The north-facing escarpment in the vicinity is generally less than 100 ft. above the Keele surface, and less than 50 ft. half a mile due north of Whitmore Station; that is to say that the total thickness of Bunter rocks composing the escarpment is less than 100 ft. It can hardly be argued that so great a variation in the thickness of the Bunter rocks is due to local conditions of deposition over an irregular floor. The base of the Bunter Pebble Beds to the north of Caverswall is at 850 ft, 250 ft. above the crest of the Bunter escarpment at Whitmore. Whatever the conditions of deposition, it is difficult to visualise the 50 ft. of Bunter Pebble Beds in the Whitmore escarpment as representing the complete original deposit, when deposition commenced at 250 ft. above this level 11 miles away. If, in order to have 50 ft. of Bunter Pebble Beds as the original thickness at Whitmore, the superior height at Caverswall is attributed to post-Triassic movement, no further

discussion is required since this would give an inclination in the sub-Triassic surface which is not shown by the Keele surface. In other words the Bunter Pebble Beds feature has been considerably planed off. That it continues to be a feature is consistent with the suggested sub-aerial formation of the Keele surface, and is an indication of the integration of the Trent drainage above Trentham.

AGE OF THE KEELE SURFACE

In view of these facts it appears reasonable to assign a post-Triassic age to the Keele Surface. If this is accepted, the precise age within the Tertiary period is more easily considered in a wider context correlating other work on denudation, but certain chronological limitations are imposed within the coalfield. Obviously the surface is at least earlier than the last ice advance which affected the area, since boulder clay is present upon it. This provides an upper limit. A lower limit is provided by the Butterton dyke. This dyke or dykes extends from Butterton through Swinnerton to Norton Bridge (3 miles south-west of Stone). It is undoubtedly post-Triassic from stratigraphical evidence. From the petrological evidence it was dated by A. Scott as early Tertiary. Jukes Browne argued from this dyke (and others of the same age in the Midland coalfields) that the volcanic forces, which affected Scotland, here probably gave rise to intrusions and local uplifts without surface eruptions.⁽¹⁾ It does indeed seem reasonable to suppose that the dyke is the result of activity which also caused movement along the old faults. It is to be noted that the dyke, like the faults, has a north-north-west to south-south-east direction. This Tertiary movement along the faults would mean that any sub-Triassic surface would have experienced dislocation in Tertiary times. This is relevant to the previous discussion of the evidence of the faults and their restricted surface expression. Furthermore it provides a lower limit for the age of the surface since the planation is obviously later. The dyke likewise has only a slight physiographic expression and is undoubtedly truncated by the Keele surface. The dyke evidence is thus corroborative with that of the faults and we may conclude therefore that the surface is mid- or late Tertiary.

AGE OF THE TRENT

The Keele surface is therefore not evidence that the Trent head-streams are the direct descendants (in the sense of occupying the same general course) of a pre-Triassic drainage. The only evidence for the pre-Triassic and Triassic drainage is in the Bunter deposits—their form, distribution and floor.

It was this evidence that Jukes discussed in his two articles on the geology of Derbyshire and North Staffordshire, and which led him to make the suggestion (though not in an explicit form) that the Trent follows the line of an earlier drainage.⁽²⁾ He considered that the break between the Leicestershire and Nottinghamshire coalfields was an

(1) A. J. Jukes-Browne, *The Building of the British Isles*, 1911, p. 380.

(2) J. B. Jukes, "The Geology of the North Part of the County of Staffordshire" and "Sketch of the Geology of Derbyshire", *The Analyst*, Vol. IX, 1839, pp. 1-32 and 233-240.

erosional feature, due to the activity of this stream, and afterwards filled by Trias. The outlier of Trias in the Churnet valley and the tongue of Trias in the lower Dove valley would similarly point to traces of what must have been left-bank tributaries (Fig. 3). "The fact of New Red Sandstones running up the valley of the Dove and lying several miles along that of the Churnet following their windings, and resting with its horizontal beds against their broken and eroded banks, shews in the most striking manner that the Carboniferous rocks had been elevated and disturbed and that these very valleys had been scooped out in them before the deposition of the New Red Sandstone."⁽¹⁾

In a like manner the Blythe Brook is now excavating the Caverswall tongue of Trias which Gibson suggested is also an infilled valley (Fig. 2). It is to be noted, however, that in this tongue the Bunter forms a rim to Keuper Sandstone and Keuper Marl outcrops. All three formations are inclined and the Keuper Marl is partly faulted against the Bunter. This therefore is no simple infilling as described by Jukes, but at least partly tectonic. It may be that the Trent valley above Trentham was once a similar tongue, revealed after the higher material had been stripped away. This would have given the Trent in this area an advantage, which, coupled with that derived from the Etruria Marl outcrops noted above, would go far to explain its ascendancy as the trunk stream. However it is not necessary to invoke a pre-Triassic valley for this. Post-Triassic movements along the Apedale and Newcastle faults would explain, would indeed demand, such a tongue.

The Upper Trent drainage thus shows signs of adjustment to the Trias, whether faulted or infilling ancient valleys. It would be wrong to infer from this, however, that the drainage in any close way resembles that of Triassic time. Jukes-Browne considered from the thinning of the Bunter Pebble Beds that an island existed over the present southern Pennines in early Triassic time.⁽²⁾ The Churnet Trias would represent an infilling of a valley, cut by a stream draining the southern flanks of the island. The present Churnet, near Leek would thus, for a few miles, be aligned with an ancient predecessor, but the drainage, as a whole, is unmistakably superimposed. An estimate by Jukes-Browne of the later sediments which covered the Palaeozoics in this area totalled 3,200 ft. ⁽³⁾ This thickness of masking material would make the possibility of a general coincidence between the older (early Triassic) and the newer (Tertiary) drainage remote. The disruption of the sub-Triassic surface by faulting and volcanic activity (of which Jukes was unaware when he wrote his articles in "The Analyst") would surely mean that a general coincidence was at best only remotely possible, and in fact highly improbable.

CORRELATION

Finally there remains to be considered the correlation between the ideas here expounded and the views expressed in other studies.

K. M. Clayton has detected in the Middle Trent basin a number of erosion levels.⁽⁴⁾ His uppermost level is of course the 1,000 ft. surface of the Southern Pennines. Mow Cop and the Cloud, and a number of

(1) *Ibid.*, p. 236.

(2) A. J. Jukes-Browne, *op. cit.*, p. 222.

(3) A. J. Jukes-Browne, *op. cit.*, p. 382.

(4) K. M. Clayton, "The Denudation Chronology of part of the Middle Trent Basin", *Institute of British Geographers Transactions and Papers*, No. 19, 1953, pp. 25-36.

other eminences and ridges east of the coalfield, all reach 1,000 ft., and it is probable that they formed part of the western extension of this surface. The most widely developed of Clayton's lower surfaces is the composite Yeaveley surface which rises to 495 ft. The extent and form of the Keele surface demands a long period of still-stand, and since it descends to 500 ft. it is tentatively suggested that the Keele surface is the upstream continuation of the Yeaveley surface. Between the Yeaveley surface and the 1,000 ft. surface Clayton has two further surfaces, both composite. Traces of intermediate surfaces can also be seen in the vicinity of the Potteries—notably at 800+ ft. Concurring with the views of Professor Swinnerton,⁽¹⁾ Clayton suggests that the 1,000 ft. surface is the Pennine representative of the Miocene summit plain of South-East England. This accords well with the observed relationships between the 1,000 ft. surface and the Keele surface (Fig. 5) and the chronological limitations discussed above. Indeed it would be consistent both with the local evidence and with the evidence from South-East England to regard the 1,000 ft. surface as Miocene* and the Keele surface as Pliocene. This in turn provides the possibility of a linkage further afield. It is certainly most relevant to a consideration of the hypothesis of Triassic pediplanation in the south-west peninsula and would lend support to Balchin's interpretation of the upland surfaces of Exmoor as Tertiary in origin,⁽²⁾ and to Brown's work on the age of the surfaces of North Wales.⁽³⁾ It is also relevant to Professor Linton's work on the English drainage system. As is well known Professor Linton has suggested that the initial pattern of consequents of the present English drainage system was west-east, rather than north-west to south-east.⁽⁴⁾ He has suggested that the proto-Trent rose originally in the Welsh Mountains and that the north-north-west to south-south-east Trent headstreams (Churnet, etc.) represent a remnant of the left bank tributary system. That is to say, the south-south-east sloping surface from which the Trent drainage was superimposed would be part of the northern half of the proto-Trent basin. This would again point to a Tertiary origin for the Keele surface, but nevertheless, since Professor Linton considers that the east-west consequents originated in early Tertiary time there is a chronological problem. It is difficult to accept an early Tertiary age for the Trent headstreams. The difficulty arises in two ways. First because of the fault and dyke evidence already discussed, and secondly because of the marked regularity of the north-north-west to south-south-east alignment, especially when it is recalled that it is shown by some streams not yet incised into the Palaeozoics. The faults at least, and the dolerite if it reached the surface would surely have disrupted the drainage, and it is difficult to visualise such a regular alignment preserved over a very long period by streams whose courses are restricted to Triassic outcrops,

(1) H. H. Swinnerton, "The Denudation of the East Midlands", *Report of the British Association for the Advancement of Science*, 1935, p. 375.

(2) W. G. V. Balchin, "The Erosion Surfaces of Exmoor and Adjacent Areas", *Geog. Journ.*, Dec., 1952.

(3) E. H. Brown, "Erosion Surfaces in N. Cardiganshire", *Institute of British Geographers Transactions and Papers*, 1950.

(4) D. L. Linton, "Midland Drainage; some considerations bearing on its origin", *The Advancement of Science*, Vol. VII, No. 28, 1951 pp. 449-456.

* the 1,000 ft. surface has also been considered sub-Triassic—W. G. Fearnside "The Geology of the Eastern Part of the Peak District", *Proc. Geol. Assoc.*, 43, 1932, pp. 153-190.

often indeed to the Keuper Marl. It is further to be noted that Professor Wills has advanced the opinion that the horst coalfields of the Midlands may have moved in mid-Tertiary times and it was this movement which flexured the Triassic basins contained between the horsts.⁽¹⁾ Both the South Staffordshire and the Leicestershire coalfields have intrusions similar to the Butterton dyke, so that there is at least the probability of movement in the early Tertiary. Jukes-Browne, after considering in detail the various strands of evidence, came to the conclusion that late Eocene or early Oligocene was probably the period during which the Pennine uplift took place.⁽²⁾ It would appear, therefore, that a later origin than that envisaged by Professor Linton is required for the east-west consequent system, or else such a system in the North Midlands was completely disrupted by the later earth movements.

SOME GEOGRAPHICAL ASPECTS OF GAS PRODUCTION IN THE EAST MIDLANDS

PETER A. BROWN

Economic geographers have paid little attention to the locational aspects of the gas industry. This has probably been the result of the obviously close locational relationship which exists between gas production and its markets and the apparently consequent lack of any significant geographical problem. Recently however, nationalisation has brought some notable changes in the pattern of gas production and has given emphasis to the different geographical problems which exist within the gas industry between industrial and agricultural areas. The East Midlands Gas Board region⁽³⁾ includes both agricultural areas and industrial areas located on and away from a coalfield, and would seem therefore to give a reasonable picture of conditions affecting the gas industry as a whole. It is with the geographical aspects of gas production under these varying conditions and the geographical changes which have followed the nationalisation of the industry that this paper is concerned.

THE PRESENT PATTERN

The pattern of gas production in the East Midlands is broadly similar to that of urban population, but in detail three subdivisions can be discerned. (Fig. 1). In the predominantly agricultural area comprising Lincolnshire, Rutland and Nottinghamshire east of the coalfield, gas production is associated with most of the larger settlements and output is closely proportional to population. On the coalfield by contrast, a more marked concentration of production is apparent, the pattern being dominated by two major groups of gasworks. The first and largest group centres on Nottingham and Derby, the second on

(1) L. J. Wills, in *Birmingham and its Regional Setting, a Scientific Survey*, British Association for the Advancement of Science, 1950, pp. 15-36.

(2) A. J. Jukes-Browne, op. cit., p. 384.

(3) This comprises the total area defined in figure 1. Statistics are published by divisions and are not available in detail for the Sheffield and Rotherham division so that it has necessarily been omitted from this study.

Mansfield and Chesterfield to the north. No gasworks are located in the several smaller urban centres between these two groups, centres which are as large or larger than many of those in Lincolnshire which have their own gasworks. Furthermore, over 40% of the total gas produced on the coalfield is derived from coke-ovens and at the northern group of stations the proportion is considerably above this average.

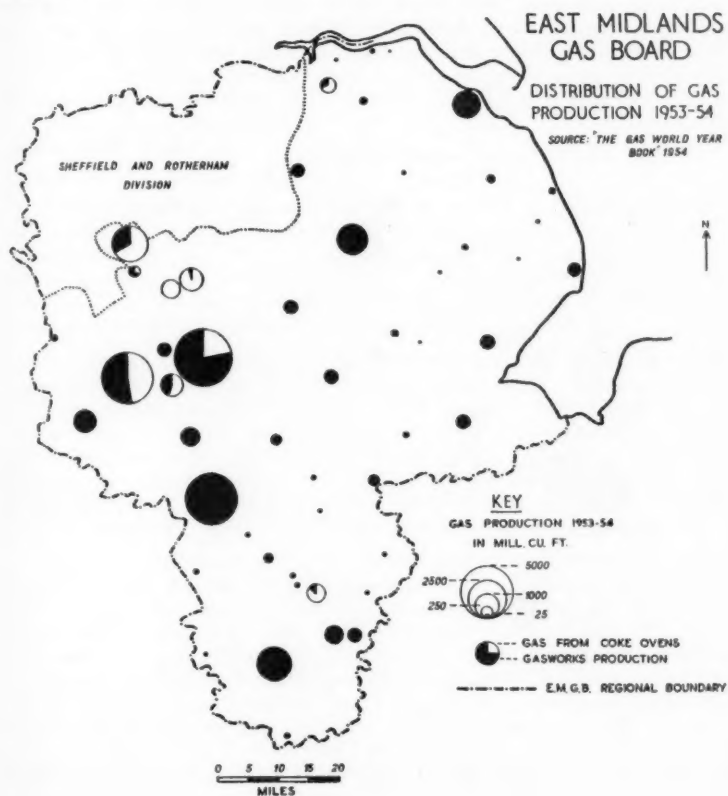


Fig. 1

In the remaining subdivision, the southern 'promontory' of the region, the pattern is transitional in character between that of the coalfield and that of the primarily agricultural area. Some concentration into the chief centres, Leicester and Northampton, is apparent, but this is less well marked than on the coalfield, and is uncomplicated, except at Kettering, by the inclusion of coke-oven gas. Moreover, output at Leicester and Northampton is considerably smaller in relation to population than at Nottingham and Derby while the pattern in the Mid-Northants industrial belt is more dispersed, with smaller units of production similar to those of Lincolnshire.

CHANGES SINCE VESTING DAY

Since the nationalisation of the gas industry came into effect in May 1949 a concentration of production has been taking place. (Fig. 2). This has involved a twofold expansion, firstly of the output and storage capacity of the largest and most efficient gasworks, and secondly of the quantity of coke-oven gas absorbed by the industry. Small and inefficient gasworks near these larger units are being progressively closed down or converted into distributing stations supplied by bulk mains from the larger works. The extent of the projected mains is shown by Fig. 2.

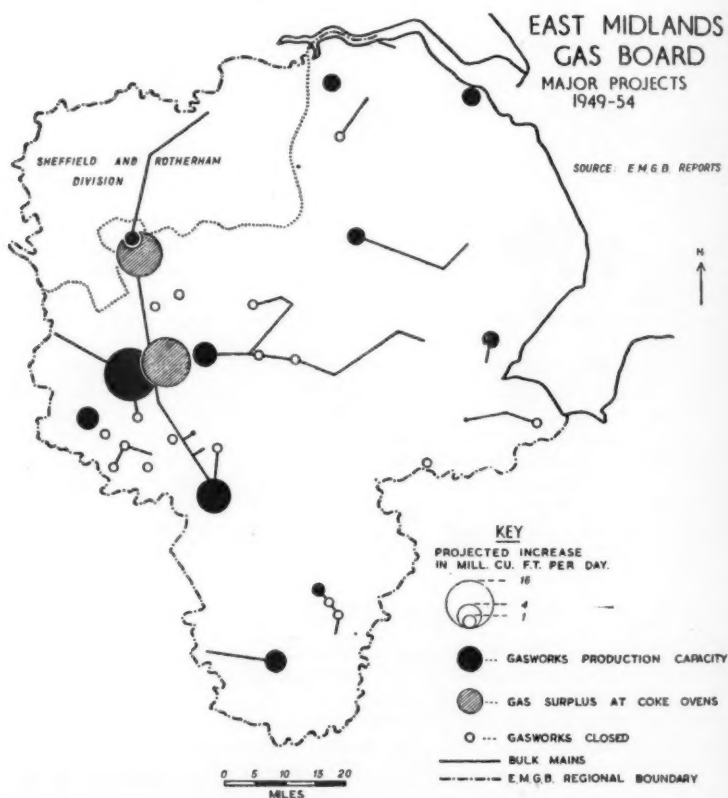


Fig. 2

This change in pattern has been most clearly marked on and around the coalfield where the largest gasworks are located and where coke-oven gas is most readily available, but the pre-existing larger units of production within the primarily agricultural areas are also involved in the expansion, and small works nearby are being closed down.

Two problems are related to the pattern of gas production and the changes which are taking place. The first is to find the reasons for the present pattern with its threefold subdivision; the second, to account for the increasing concentration of production especially on the coalfield, and for the expanding use of coke-oven gas.

THE FACTORS INVOLVED IN LOCATION

The major economic factors involved in the location of gas production are labour and market, and coal and/or a surplus of coke-oven gas. Each factor will be examined in turn in an attempt to discover how far it has affected the location of gas production and the change in pattern since nationalisation.

Labour and Market.

The close spatial correlation between the distribution of gas production and population points to the existence of a strong causal relationship between the two patterns. It is as a market for gas that population exerts a locative influence. Labour has little if any significance as a locative factor. Basford gasworks at Nottingham for example is one of the largest in the region but employs only 300 men.

Gas production must take place near to a sizeable and relatively compact market. Costs of distribution are high and increase rapidly with decreasing population density. Even in highly industrialised areas domestic consumption rarely falls below 60% of the total and in agricultural areas this proportion is much higher. The domestic market consists of a large number of small consumers each requiring a pipe and meter system so that gas supply is economically restricted to urban-type settlements⁽¹⁾ with a relatively high density of consumers.

These economic considerations have been reinforced by the nature of the historical development of the gas industry. Prior to its nationalisation, gas production and supply were controlled almost entirely by independent companies and local authority undertakings.⁽²⁾ Each company operated in a statutory area under low maximum price and dividend rates imposed in the consumer's interest. Consequently there was little financial incentive for companies to amalgamate and the amount of integration was negligible. Similarly there was little co-operation between local authority undertakings, usually because of differences in local fiscal policy. Even when progress in transmission technique had made some measure of integration possible and economically desirable it seldom took place.⁽³⁾ As late as 1945, there were in the whole of Great Britain only five Joint Gas Boards involving two or more local authority undertakings, supplying only 1.1% of the total quantity of gas marketed. Thus, it would seem that social and political factors have emphasized the spatial correspondence between gas production and markets beyond economically desirable limits.

(1) This is clearly illustrated by the O.S. 10 miles to 1 inch map of Gas and Coke production in Great Britain. (1949).

(2) In 1945 52% of the gas marketed in Great Britain was produced by independent companies, 11.2% by holding companies, and 35.7% by local authority undertakings.

(3) See *The Gas Industry; Report of the Committee of Enquiry*, H.M.S.O. 1945, Cmd. 6699, pp. 15 and 19.

Coal and Coke-oven Gas.

The major raw materials required by the gas industry are coal of suitable type and/or coke-oven gas. In general it is cheaper to transport coal than to transmit gas so that coal is not a locational factor but influences only the detailed siting of gasworks through the need for a site with good transport facilities. Proximity to a good road or railway is also necessary for the distribution of coke produced at the gasworks.

Since 1918, coke-oven gas which was formerly burned off to waste has become increasingly important in the 'consumer gas' industry. It is essentially a raw material requiring purification at the gasworks, and "provided the scale of manufacture is sufficiently large the coke-oven is the most economical known method of making gas to meet base-load demand".⁽¹⁾ It is therefore able to bear higher transmission costs than refined 'consumer gas' and can be economically distributed over a wider area. Unfortunately however the production of coke-oven gas is determined by the demand for coke which bears no relationship to the demand for 'consumer gas' which is determined largely by the domestic market with its well defined daily and seasonal peaks.⁽²⁾ Consequently coke-oven gas can be economically supplied to base-load markets alone, and must then be supplemented by storage and stand-by capacity to operate only for peak periods and therefore at a low rate of efficiency. It would appear that on the coalfield the base-load markets for coke-oven gas are now saturated since there remains a surplus which cannot be used economically except in more distant centres of high base-load demand. In order to reduce transmission costs this surplus is refined at gasworks close to the coke-ovens. Hence, where the end product is to be consumed by base-load markets located away from sources of coal, the site of the coke oven becomes the major factor affecting the location of the gasworks.

In the case of Scunthorpe and Corby the coke-ovens are orefield-located and there is a high demand for coke-oven gas as fuel for the adjacent steelworks. Thus, the surplus available to the gas industry is relatively small and can be absorbed entirely in nearby base-load markets.

CONCLUSIONS

Having examined the factors it is now possible to account for the present pattern of gas production.

Because the costs of gas transmission and distribution are high, generally exceeding costs of coal including transport, gasworks are located close to compact and often localized markets. The only exception occurs when the source of raw material is a coke-oven, located near to coal sources and at some distance from the ultimate market. In this case, the gasworks is located near to the coke oven and in effect at the source of coal. The complementary stand-by plant is market-located since it is coal-burning. However, within the coalfield the location of coke-ovens would seem to have little effect upon the location of gasworks which occurs at points centrally placed to serve large and compact

(1) *First Report and Accounts of the East Midlands Gas Board*, 1949-50, page 16.

(2) It was estimated by the Heyworth Commission in 1945 that 50% of the total gas sold was consumed by the domestic cooking demand which has very definite daily peak periods.

markets. Thus there are concentrations of production in the Nottingham-Derby area, and in the Chesterfield-Mansfield Area, while the intervening and surrounding zones are devoid of gasworks of significant size. (Fig. 1) This concentration on the coalfield is however to a large extent a feature of the change in pattern since nationalisation and comes therefore within the scope of the second problem, namely, what accounts for the change shown by Fig. 2.

At vesting day the East Midlands Gas Board was faced with an industry which was too decentralised due to the unintegrated nature of its historical development. The gas industry must always be characterised by a large measure of market location but the degree of decentralisation existing in 1949 was uneconomic because of the unnecessary duplication of plant involved and of the difficulties of absorbing coke-oven gas into a series of small dissociated gasworks.

The first object of the Board was therefore to improve and expand the largest and most efficient gasworks, then to close down small and inefficient works within easy transmission range, supplying these from the former.⁽¹⁾ Secondly, it was necessary under the stimulus of increasing costs and fuel shortages to make fuller use of the coke-oven gas surplus.

Both aims were most easily realised on the coalfield because there the largest and most efficient stations already existed together with a dense and compact market including a high industrial demand, and relatively cheap supplies of coal and coke-oven gas. Thus the largest schemes for expansion were approved firstly for the Burton-Derby-Nottingham line of gasworks, secondly for Leicester, and thirdly for the larger pre-existing centres of Northamptonshire and Lincolnshire. These gasworks are to supply base-load gas to the adjacent smaller works which will operate only as peak load stations and will go out of production entirely as they become obsolete. No further expansion is envisaged for gasworks at moderate sized and relatively independent centres like Loughborough and Burton since it is hoped that these too may ultimately be closed down and served from the major centres as transmission technique advances.

In Lincolnshire, where costs of production except in one or two of the larger gasworks are relatively high, the distances between towns and the consequential costs of laying interconnecting mains are such that integration is possible only to a limited extent. The pattern in the primarily agricultural areas of the East Midlands is therefore likely to change little, though the ultimate aim is to concentrate production into the ten or so largest gasworks existing at present.

Since vesting day the surplus of coke-oven gas available to the gas industry has been expanding. To facilitate its distribution to markets on and around the coalfield a mains network is being constructed with a northward branch to tap the surplus which cannot be economically utilised in the Sheffield and Rotherham Division.

(1) "... operating efficiencies tend to increase progressively with the size of works up to a maximum of about 10 million therms (about 2,080 million cubic feet) per annum. Thereafter no further advantage is to be gained by size and there may even be a decline in efficiency due to the increased cost of coke disposal". *The Gas Industry; Report of the Committee of Enquiry*, H.M.S.O. 1945, Cmd. 6699, page 19.

In 1953 it became apparent that the surplus of coke-oven gas which would be available from 1956-62 would exceed the economic limits of the intake capacity of coalfield-located gasworks by some 21 to 24 million cubic feet a day during the summer months. Since this surplus could however be economically sold in fairly large and compact base-load markets located at some distance from coal sources, the expansions in production capacity approved for Northampton and Rushden were suspended in favour of an extension of the gas distribution network to these centres. Thus, gas production for the Mid-Northants market is in effect shifting partly to the coalfield and it is unlikely that there will be any immediate changes of significance in the pattern of gas production within this part of Northamptonshire.

In conclusion, it is interesting to note the similarity which exists between the changing pattern of gas production as exemplified by the East Midlands, and that of electricity production. The present tendency, under nationalisation, for gas production to become concentrated into the larger urban centres was paralleled in the electricity industry more than two decades ago.⁽¹⁾ The considerable time lag between these comparable geographical changes has been the result of the prolonged control of the gas industry by independent companies and local authorities as opposed to the system of national supervision which was established over electricity production as early as 1919 and strengthened in 1926. The seeming concentration of gas production near sources of coal may be compared too with the vastly greater, but geographically similar change in electricity production. This latter analogy must not be pressed too far however because of the differences in scale and reasons behind the movement as between the two industries. Moreover, both trends towards a further concentration in the pattern of gas production are likely to be limited since it seems probable "that in view of the present size of the industry, a national grid could not be justified on technical or economic grounds."⁽²⁾

REFERENCES

1. East Midlands Gas Board Report and Accounts 1949-54.
2. The Gas Industry ; Report of the Committee of Enquiry. (The Heyworth Report). H.M.S.O. 1945. Cmd 6699.
3. The British Fuel and Power Industries. P.E.P. 1947.

(1) See E. M. Rawstron, "The Salient Geographical Features of Electricity Production in Great Britain", *Advancement of Science*, Vol. 12, No. 45, June 1955, pp. 73-82.

(2) "The Gas Industry ; Report of the Committee of Enquiry", H.M.S.O. 1945, Cmd. 6699, page 20.

A NOTE ON THE FLETTON BRICK COMPANY'S WORKS AT BLETCHLEY

P. S. RICHARDS

In a brief study of a particular brickworks within the Oxford Clay Vale this note attempts to illustrate and amplify some of the points made in the more general article which appeared in the last issue.⁽¹⁾ The works concerned are those of the Fletton Brick Company at Water Eaton near Bletchley which were opened in 1934. The London Brick Company had been operating in the district for some years previously and indeed the semi-dry process for the manufacture of Fletton bricks had been in use in the locality since before 1914. The success of these earlier works and the availability of a suitable site near Bletchley may be said to have prompted the Fletton Brick Company to locate their works in this district, just as the more extensive developments having taken up the best sites near Bedford and Peterborough may be said to have discouraged the choice of a site in those localities. The map shows the location of the Fletton Brick Company's works and of two others in relation to the railways, the town, the main roads and the relief and drainage.

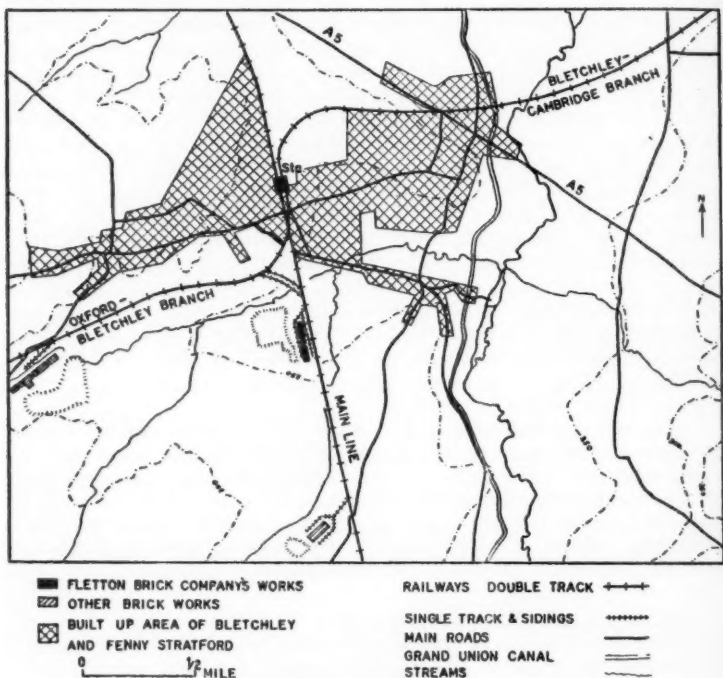
The raw material used is the Lower Oxford Clay which, overlain by a very shallow overburden, is sixty feet thick in this area. The Clay is very suited to brick manufacture. It consists of a laminated shale and clay and contains an appreciable amount of oil which helps to reduce firing costs. The Clay is easily moulded and furthermore it is then sufficiently strong to withstand fairly rough handling and still reach the kiln ready for firing without being damaged in any way.

One and a quarter acres are quarried annually to supply the plant. The approximate extent of land worked up to 1953 is shown on the map. Occasionally the quarries become waterlogged after very heavy rainfall and pumps are used to remove the water, which, if it were absorbed by the clay, would spoil its excellent brick-making qualities.

On account of the considerable oil content of the clay, coal requirements amount to less than two hundredweights per thousand bricks. This is substantially less than for most other clays. The coal used is known in the industry as 'smudge' (slack coal) and tipper lorries, each carrying ten to twelve tons, bring it to the works from the Leicestershire coalfield. The distance is sufficiently short to allow the lorries to make a double journey every day. The completed bricks are loaded straight on to lorries at the works and sent to destinations all over the country in competition with the local product. Delivery direct to the building site without intermediate handling helps to keep down costs and has reduced damage to almost negligible proportions. Situated near Watling Street (A5) the works have excellent road connections with much of the more populous part of Britain.

(1) Pamela R. Healey and E. M. Rawstron, the Brickworks of the Oxford Clay Vale, *East Midland Geographer*, No. 4, December, 1955, pp. 42-48.

The Fletton Brick Company's works are prominent features of the landscape alongside the main railway line from Euston to the north (see map). The site here was chosen because of the presence of the railway line (cf. the other works shown on the map) and sidings were built to serve the works when they were first opened, both coal and bricks being transported by rail at that time.



Brickworks near Bletchley.

This examination of conditions at the Fletton Brick Company's works near Bletchley confirms the findings of the earlier article in respect of the clay and the importance of the railway in providing access for coal and to the market. Although ample labour was available owing to the high level of unemployment in the nineteen-thirties when the works were opened, the significance of the town of Bletchley as a source of labour and as a residential area for immigrant workers must not be overlooked. Today the works are rather understaffed and foreign labour is used as at Bedford and Peterborough.

The works produce one and a quarter million bricks weekly which, added to the three and three quarter millions made by the London Brick Company in the Bletchley district makes the latter as important as the works at Calvert. This fact is relevant to the discussion in the earlier article of the relative size of output of the four major groups of works in the Oxford Clay vale.*

*The help of Captain Mells of the Fletton Brick Company in providing much of the data on which this note is based is gratefully acknowledged.

*In the earlier article it is stated that "Figure 2 shows the approximate weekly output of the four groups of works belonging to this company" i.e. the London Brick Company alone. This is not however made clear on the figure itself. Detailed statistics of the works of other brick makers in the Oxford Clay Vale were not available to the authors and could not therefore be mapped to complete the picture. This omission does not, as Mr. Richards in some measure shows, invalidate the general findings nor may it greatly alter the pattern on Figure 2 since the London Brick Company produces almost three quarters of the bricks made in the Vale, but it does make unnecessary the attempt in the earlier article to account for any difference in size between the works at Calvert and those at Bletchley. Ed.

LOUTH: A NORTH LINCOLNSHIRE MARKET TOWN

H. E. GOULDING

Louth, on the small river Lud, is situated in a fertile east-west valley in the Boulder Clay at the eastern foot of the Chalk Wolds in north-east Lincolnshire. It is sheltered to the north and south by hill slopes of indurated chalk bearing a clayey soil several inches deep. (See Fig. 1) Eastwards, a flat coastal plain stretches to the North Sea some twelve miles away. Louth is the only settlement on the Chalk-Boulder Clay junction which has attained the status of a town despite its relatively isolated position. The Wolds with their treeless hill and dale scenery effectively cut off communication westward, the sea is only a few miles to the east and the broad estuary of the Humber virtually precludes the development of any important route to the north apart from that to Grimsby.

Little is known of the early development of Louth. An unfortified Roman settlement of the villa type was sited on the gently sloping southern bank of the Lud. Both prior to and during the Roman occupation, a British camp was maintained on the high ground above the ancient chalk sea-cliff, a location favoured by abundant spring water and the availability of fuel from the forested Boulder Clay. The main function of this camp was defensive, for it dominated a wide section of the bordering plain and coastal marshes.

The Domesday Survey of 1086 revealed Louth to be one of the five boroughs existing in Lincolnshire and to have one of the fifty markets (to the value of 29s. per annum) recorded in England. At the end of the eleventh century this market was mainly used for local produce passing through the hands of corn merchants and millers but in the following century the business of the town expanded greatly.

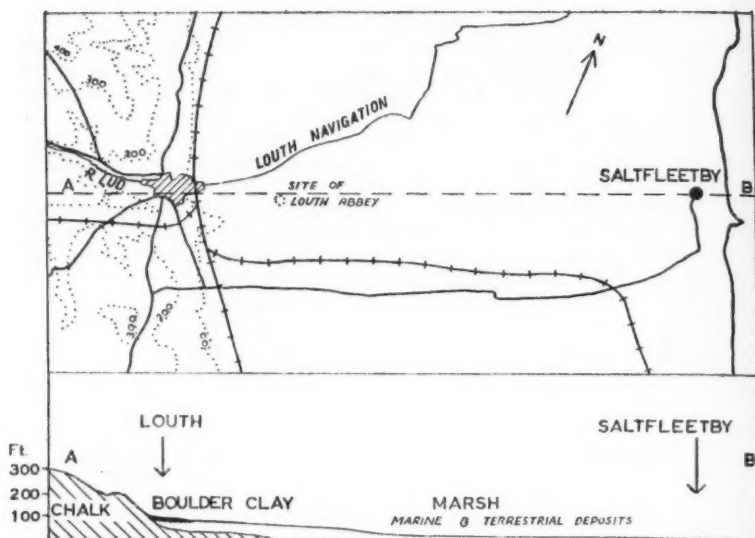


Fig. 1
Position of Louth.

PROSPERITY FROM WOOL

Under the influence of a Cistercian Abbey (1139) situated at Louth Park, sheep rearing on the Wolds became widespread. Records for the period 1202-06 show that wool was the predominant export, with the trading arrangements in the hands of Flemish merchants. During the same period wine was the largest single import and there were thirteen vintners in the town to deal with the trade. A few years later Louth was sufficiently important as a market centre for Italian merchants to settle in the town, buy the wool and send it to Flanders.

With the return to normal conditions in Lincolnshire following a period of depopulation caused by the Black Death, wool, including cloth-making, became of supreme importance to Louth, although it resulted in a markedly unbalanced economy. The exclusive dependence on wool resulted from the fact that it was the most profitable agricultural product in the area and one which called for a minimum of labour at a time when man-power was anything but plentiful. Transport to Flanders through Boston moreover was well established, while movement to newer cloth-making centres in Yorkshire was relatively easy. As a memorial to these times the elegant parish church, with its beautiful tower and spire dating from 1501, survives as the outstanding architectural feature of the town. The age of prosperity which wool brought to Louth ended in 1536 with the dissolution of the monasteries and it was not until after the mid-eighteenth century that the town began to recover from this misfortune which was further accentuated later on by changes in wool manufacturing leading to the concentration of output in west Yorkshire.

EIGHTEENTH CENTURY REVIVAL

The revival of activity was assisted by two circumstances. Firstly, arable farming in the Wolds was stimulated by the rise in wheat prices and secondly the marketing of farm produce, especially wheat, barley and beans, was extended as a result of the construction of a canal in 1762 connecting Louth with the sea at the tidal estuary of Tetney Haven. This was done by regulating the Lud. The Louth Navigation, fourteen miles long, became an enormous asset to the town and neighbourhood with vessels plying regularly to London, Hull and other Yorkshire ports. Water carriage reduced the cost of coal, building-stone and road materials; it stimulated the growth of corn mills and iron foundries in Louth and helped to revive the town's market functions. Even the traditional industry of cloth-making was successfully resuscitated although its location, even by eighteenth century standards, was not particularly favourable especially as regards power.

About 1800, Adam Eve founded a carpet factory whose products quickly gained a European reputation, while later on carpets and blankets, starting as an enterprise of the town corporation, were manufactured on a large scale employing over 100 people. Other industries on a small scale attracted to Louth at this time in view of the facilities provided by the canal, included tanneries, roperies, two ship building yards, oil-cake and bone-grinding works and several breweries. This revival was emphasised by the transference of the market for lean sheep, cattle and pigs from Saltfleet to Louth in 1803. Here it should be noted that the population graph shows the comparative importance of Louth at this time, Grimsby being merely a large fishing village with about 1,500 people (Fig. 2).

Yet Louth never quite regained its medieval importance. The ground lost between 1550 and 1750 was too great to be recovered by a town which lacked adequate water power, coal and raw materials during the Industrial Revolution. Without such resources Louth was unable to attract further industry and even with the development of inland waterways and turnpike roads over the rest of the country, the town suffered from its distance from London and other large centres. When some of these difficulties might have been overcome by the growth of the railways, external factors such as the rise in imports of cheap grain from abroad retarded the agricultural development of the Wolds and Marsh which in turn seriously affected Louth as a market town. The town further suffered as a result of the prolonged depressions in farming during the periods 1826-46 and 1860-1900. Reference to population figures for 1841, 1851 and 1901 emphasises two facts. Firstly, even allowing for the boom in agriculture after the repeal of the Corn Laws in 1846, the railway reaching Louth in 1848 did little to increase the town's growth. Secondly, even with the improved communications the population trend during the second half of the nineteenth century shows how intimately town and hinterland were bound together, for the effect of the farming depression was reflected in a net decline of 950 people, while other towns, notably Grimsby and Lincoln, were able to utilise the benefits of the railways to establish themselves indisputably as the leading centres of population in Lincolnshire.

The post-1762 developments in Louth produced changes in the form of the town. Although the old core, centred on the market place, remained unaltered as the commercial sector, the river Lud and the

canal bank became the industrial districts of the town. Here the availability of cheap building-land brought a hive of small factories and mills to the "dock" area, around which arose a separate community with its own tavern, "The Woolpack", and worker's cottages. The western part of the town began slowly to fill up. This was, and still is, the better class residential area. The general absence of new buildings in the eighteenth and nineteenth centuries suggests that industrial development did not promote an increase in the number of wealthier townspeople or, if it did, that such were not disposed to live in the western part. In fact the town expanded most towards the east and south where middle-class and artisan dwellings were built without any apparent plan. North of the Lud terraces of artisans' cottages were added to the old Cisterngate district by means of the bridges over the Lud on the Grimsby Road and on Enginegate, making this area a definite part of the town instead of an offshoot.

The coming of the railway inspired a new phase of building without attracting further industry. Artisan terrace-dwellings clustered round the railway station while middle-class houses completed the infilling in a general east-west direction. Development north and south was slight, with the result that the town maintained a somewhat elongated form with the best residential area, the church, the market place, the railway and the canal linked together.

IMPORTANCE OF ROAD TRANSPORT

Modern roads have proved the greatest asset to Louth since the completion of the Navigation in 1762, although it was not until the second world war, which made exceptional demands on agriculture, that Louth was able to take full advantage of road transport and reassert itself as an active country town. Largely as a result of its long tradition as a market centre, Louth has gained more through the wartime and post-war boom in agriculture, relatively though not absolutely, than all the other market towns in Lincolnshire. For the first time in its history the population has exceeded 11,000 and is still increasing. (See Fig. 2) The importance of road haulage may be judged by the fact that every industrial concern in Louth is now dependent upon it, even those with railway-siding facilities.

TOWN AND HINTERLAND

The obvious place from which to start a study of present-day Louth is the market-place. An open market is held each Wednesday and stalls occupy much of the market-place itself, the Corn Market and a part of Mercer Row. In addition to local stallholders, others come from as far afield as Leeds, Sheffield, Leicester and Wisbech. The large market hall is open every weekday for the sale of food, flowers, clothing and general articles. The Friday stock market is a Mecca for the farmers of north-east Lincolnshire and is the largest centre for the sale of live-stock, particularly store cattle, in the county and one of the largest in the East Midlands. It has no serious rival within a radius of 45 miles. The diversity of its sales reflects the varying emphasis in production from the different parts of the neighbourhood. Thus sheep are still reared on the Wolds; the well-watered valleys of the Chalk dip slope

are largely devoted to cattle breeding, while the Marsh has traditionally served as a summer grazing area for fat stock, with small farmers supplementing their income by keeping pigs. The latest venture adding to the town's facilities for handling livestock is a new £17,000 attested cattle market, opened in 1954, to deal with the rapidly increasing number of attested herds in Lincolnshire.

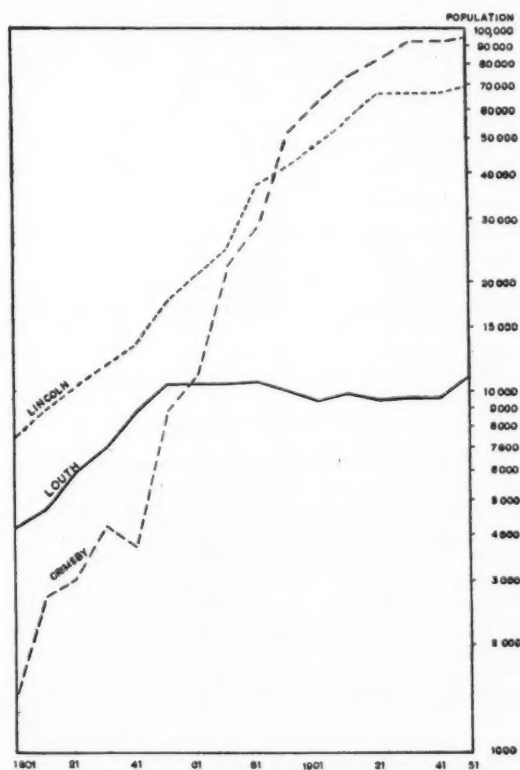


Fig. 2

Growth of population (on logarithmic scale)
of Louth, Lincoln and Grimsby.

Louth however does not rely entirely upon its market for its survival as an urban centre. There are several well-established industries concerned with agricultural products, including food-processing and preparation. Broadly speaking these depend on the Wolds for malting-barley, wheat, potatoes, peas and beans, on the Boulder Clay belt for sugar beet and root crops and on the Marsh for fruit and seeds. Malting, canning and milling are the chief forms of industry. In addition, sited in an old canal warehouse, is a branch works of a Leicester firm of glove makers.



Fig. 3. Louth hinterlands.

Besides its primary function of serving local agricultural interests Louth is a general service town and an attempt is shown in Fig. 3. to define for different purposes the extent of its hinterland. The accessibility boundary represents the area over which Louth is more readily reached than any other centre and is based on the fullest normal motor bus services including market days and Saturdays but excluding school and works buses. Taking the accessibility boundary as the limit to which Louth's function as a shopping centre extends, it can be seen that the town competes successfully with the larger centres of Grimsby and Lincoln. Another measure of the town's influence is reflected in the limit of circulation of the local weekly newspaper, "The Louth and North Lincolnshire Advertiser". Here it should be noted that large numbers of this newspaper are sold in Grimsby but few in Lincoln or Skegness, a fact which to some extent reflects the traditionally good relations existing between Louth and the great fishing port. The Louth General Hospital, built in 1937, serves a similar area although some patients are received from more distant parts of Lincolnshire and even south Yorkshire. Lastly, though not shown on the map, Louth offers educational advantages in the form of two grammar schools, to which pupils are drawn from distances up to 15 miles away, and a technical college. It should also be noted that Louth is a residential town and, probably more than any other in east Lincolnshire, attracts retired people. It is unlikely that there will be a large expansion of industry in the future although it may be argued that additional forms of employment are needed to lessen its dependence upon agricultural interests. The much broader pattern of modern farming is to the town today what wool was in the sixteenth century. While agriculture remains a profitable activity the prosperity of Louth is not in doubt but if misfortune should occur to the farms of north-east Lincolnshire the town will certainly suffer.

EAST MIDLAND RECORD

THE NEW 'AVENUE' COKE-OVEN PLANT AT WINGERWORTH

The first battery of coke-ovens at this new works came into use early this year and the entire plant should be in service shortly after the second battery begins working in the summer. This, the largest coke-oven plant owned by the National Coal Board in the East Midlands Division, and the recent large expansion of the plant at Stanton Ironworks will together contribute great quantities of gas to the public supply system in the East Midlands. The scale of their contributions is well shown on Fig. 2, page 24 in P. A. Brown's article on gas production which appears earlier in this issue. The closure of the smaller works at Pinxton and Clay Cross in recent years and at Blackwell in February 1956 must however be set against some of the expansion of gas and coke production at the Avenue Works and at Stanton.

Although gas and by-products are very important in the economic working of coke-oven plants, coke production is their primary concern and purpose. In this the plants at Stanton and Wingerworth differ to some extent, for, whereas the Stanton product is for metallurgical use at the Stanton Ironworks, the output from Wingerworth is intended for the general domestic and industrial market. It is thus both making better use of the coal and helping the current drive for a clean air policy.

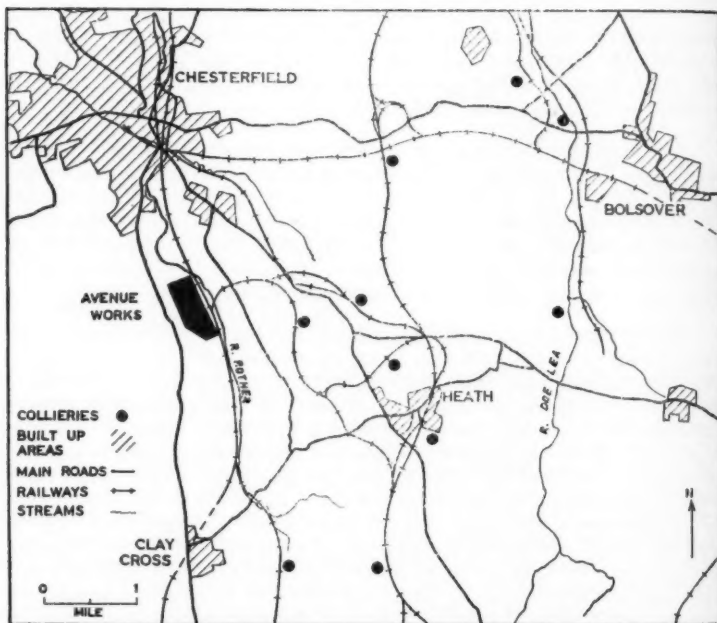
The general location of the plant is related to the sources of the type of coal required. In the Nottinghamshire and Derbyshire Field coal with caking properties strong enough for coke-oven use is found in the main towards the north and north-west. A zone running westwards from Harworth (in the north-east of the Division), widening towards Chesterfield, then curving southwards and terminating at about Pinxton would take in most of the collieries concerned, the greatest concentration being to the south and east of Chesterfield. It should be noted that that part of the zone which extends from Harworth to Chesterfield is but the southern fringe, extending a little way into the East Midlands Division, of a wide area reaching as far north as Wakefield in which large amounts of coking coal are produced. The East Midlands it may be remembered from an earlier note⁽¹⁾ is much less important for coking coal than for ordinary coal production.

The general location of the Avenue Plant is therefore within the most prolific district for coking coal production in the East Midlands and the greater part of its supplies of coal will be drawn from collieries in Area No. 1, within which it lies, of the East Midlands Division. Access to collieries to the north and south is provided by the main line railway adjacent to the works and a branch railway joining the main line near the works provides access to collieries towards the east (see map). To some extent, therefore, the site is a nodal point suitable for the assembly of coal from a number of collieries in a wide arc north, east and south of the plant. A fly-over crossing for coal trains supplying the works has been built so that interference with through traffic on the main line will be kept to a minimum.

(1) E. M. Rawstron, "Three Maps on Coal Production", *East Midland Geographer*, No. 1, p. 21.

As well as providing access for coal the adjacent main line will serve to give direct connections for the despatch of coke especially to the Midlands and southern parts of England. The same can be said of the adjacent main road for more local markets.

The site chosen has three further advantages. Large amounts of water are needed to quench the coke, to make up losses of boiler feed water and cooling water used by the back-pressure turbines in the electric power station on the site and for other processes. The River Rother (see map) supplies these needs.



Location of the Avenue works.

The second advantage, which in fact determined the exact site chosen, is stability of foundations. Mining subsidence is a problem today in many coalfields and damage from this cause has been avoided at Wingerworth by establishing the works on the site of a disused colliery. Thus the pillar of coal left to keep safe the shafts and former colliery buildings now supports the large investment in coke-ovens, power station, sulphuric acid plant, storage, sidings, by-product plant, etc., which have superseded the old colliery. The latter, the Avenue pit, has thus given its support and its name to the new works.

Finally there is sufficient space at the site to double the size of the plant (present planned output 2,200 tons of coke daily or about 800,000 tons annually), if and when conditions demand it.

E.M.R.

FLAX PRODUCTION IN THE EAST MIDLANDS

Flax as a source of fibre was formerly grown in considerable quantities in eastern England but declined in importance during the nineteenth century when improved communications enabled cheaper supplies to be imported, especially from Baltic countries. Within the East Midlands the crop was most successful on fairly light soils rich in humus such as those developed on fenland peat in Holland, east Kesteven and the Isle of Axholme. During the last war, however, in view of the shortage of fibre materials, the output of home-produced flax, then involving an almost negligible acreage, was greatly expanded under the Government's Home Flax Scheme. The crop again took its place, though not without difficulty on the smaller farms, in the rotation systems of the eastern arable and mixed-farming areas. With financial assistance under the Scheme the area sown in England was extended until in 1944 there were 60,000 acres under flax, much of it being in the East Midlands where three out of the seventeen mills equipped for processing the crop were established. Operations at these mills included seed extraction, retting, drying and scutching into long fibre. The output of fibre was absorbed by spinning mills in Scotland apart from by-products such as flax tow used in the making of rope, twine and paper. The three mills in the East Midlands were located—largely in relation to the chief flax-growing areas—at Billing (Northampton), Nocton about 7 miles S.E. of Lincoln and Ripley (Derbyshire), in each case existing premises being adapted for the purpose.

Since the war the total acreage under flax has fluctuated year by year, though on the whole, with the general return to a peace-time economy, there has been a downward trend. A sharp reduction has certainly occurred since the rather high figure of about 23,000 acres (for England) in 1951, that for 1954 being only 16,630 acres. Of the 23,126 acres cultivated in 1951, some 8,500 acres, i.e. well over one-third of the total, were in the East Midlands, mainly in Lindsey (2,799 acres) and Northants. (2,656 acres). With just over 4,700 acres under flax in 1954 the regional share was rather under one-third. Reference to acreages in earlier years is made difficult by the fact that prior to 1948 Ministry of Agriculture county statistics do not differentiate between flax for fibre and for linseed.

In August, 1954 the Government announced the gradual closing of the Home Flax Scheme and with the progressive reduction in the subsidy to farmers, it is likely that in a few years the production of flax for fibre will again become negligible. This also means that the East Midland mills, after making a notable contribution to the nation's fibre resources for some fifteen years, will cease to operate. The Billing factory closed at the end of 1955, and it is intended to close those at Ripley and Nocton in 1956 and 1957 respectively.

K.C.E.

FURTHER DEVELOPMENTS IN OIL PRODUCTION

Following the drilling operations near Plungar in the Vale of Belvoir which led to oil production in 1954 (noted in *The East Midland Geographer*, June 1954, p. 42), a further success at Egmont near Tuxford in east Nottinghamshire has recently been announced. Already there are nine producing wells but many more are to be drilled, for it is likely that a valuable source comparable in amount with that at Eakring has been located here. The Egmont structure is an anticline similar to that at Eakring but lies at a greater depth, the oil occurring

in the Millstone Grit at 3,000-3,500 ft. below the surface. The crude, like that from Eakring and elsewhere, is sent to Scotland for refining, the nearest railway being at Tuxford close to the main line to the North. With Eakring and its secondary centres at Caunton and Kelham Hills, the new developments at Egmont make East Nottinghamshire by far the largest oil-producing area in the country, yielding in 1955 much the greater part of the total output of 53,000 tons.

K.C.E.

OBITUARY

JOHN BYGOTT

We regretfully record the death towards the end of last year of Mr. John Bygott. For 25 years Mr. Bygott served as senior geography master at the Clee Grammar School, Grimsby, from which post he retired in 1944. Mr. Bygott was a native of Lincolnshire, coming from a well-known farming family, and had a distinguished career as a university scholar and research student at Oxford. A teacher of great distinction, he sent many excellent students to this Department and to other universities. It is a tribute to his powers as a teacher that a greater number of able undergraduates came from him to Nottingham than from any other school. One of these pupils who graduated at Nottingham, Mr. J. W. Fox, now senior lecturer in Geography at University College, Auckland, N.Z., contributes the following appreciation :

News has reached New Zealand that John Bygott died towards the end of 1955. His death must surely mark the end of an epoch—that of Herbertson at Oxford. There can be few geographers living today who sat at the feet of the master in the days before the first world war and none can have continued actively writing and working so late in life as did Bygott, unless it was his friend and fellow-student, the late Professor C. B. Fawcett.

In these more sophisticated times the simple philosophy of Bygott would probably be looked at askance, as would his passion for facts. To him Geography was a description of the earth's surface interpreted in the light of regional variations, the larger regions being essentially those of Herbertson's classic division of the world. To aid description and interpretation factual knowledge was essential. The more the details were appreciated, the more understandable became the general picture.

Generations of pupils benefited from Bygott's teaching. Though a stern taskmaster, he inculcated in many individuals a love of Geography that led them to pursue its studies academically and in all he stimulated an interest in the world about them so that they became the better citizens for it. His original contributions to Geography were perhaps small, the most notable being *Eastern England* (1923) and the essay on Lincolnshire in *Great Britain: Regional Essays* (1928), whilst among his school textbooks *Mapwork and Practical Geography* (1934) represents a pioneer effort which has stood the test of time. Each of these was a landmark and all bear the imprint both of Herbertson's training and Bygott's personality.

The ability to inspire is given to few but Bygott possessed it in full measure and though his work lay essentially in the realm of school-mastering, his influence was great and the world of Geography is the poorer for the passing of one who was a great exponent of the subject and one who remained as a link with the philosophy of an age when Geography as a university subject in Britain was only in its infancy.

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